

S102 PRP/S510
SCIENCE-PREPARATORY/ACCESS MATERIAL
MODULES 1 AND 2



INTO SCIENCE



MODULE 1 GETTING STARTED
MODULE 2 OBSERVING AND MEASURING

This Table gives some SI units that you will come across as you progress through *Into Science*.

SOME COMMON SI UNITS

Quantity	Unit	Symbol
length/distance	metre	m
mass	kilogram	kg
time	second	s
temperature	kelvin	K
energy	joule	J
power	watt	W
force	newton	N
area	square metre	m ²
volume	cubic metre	m ³
speed	metres per second	m s ⁻¹
acceleration	metres per second squared	m s ⁻²
density	kilograms per metre cubed	kg m ⁻³

The non-SI unit degrees Celsius (°C) is often used instead of kelvin, and is always used in *Into Science*.

Summary of rules of negative numbers.

In each of the examples the number 3 is used, but it could, of course, be any number. (A positive number is not normally preceded by a + sign. It is included here for clarity.)

$$\begin{array}{lll}
 (-3) + (-3) = -6 & , & (-3) + (+3) = 0 & (+3) + (-3) = 0 \\
 (-3) - (-3) = 0 & & (-3) - (+3) = -6 & (+3) - (-3) = 6 \\
 (-3) \times (-3) = 9 & & (-3) \times (+3) = -9 & (+3) \times (-3) = -9 \\
 (-3) \div (-3) = 1 & & (-3) \div (+3) = -1 & (+3) \div (-3) = -1
 \end{array}$$

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- 2 OBSERVING AND MEASURING
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- 4 THE SIZE OF THINGS
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MODULES 3 AND 4



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MODULE 3 LOOKING AT BUILDINGS
MODULE 4 THE SIZE OF THINGS

These formulae are introduced in Module 3:

- Area of a rectangle = length \times width
- Volume of a rectangular solid = length \times width \times height
- Density = mass \div volume
- Pythagoras' theorem:
 $(\text{hypotenuse})^2 = (\text{perpendicular})^2 + (\text{horizontal})^2$

Module 4 shows you how to handle numbers in *powers of ten notation*.

- To subtract or add two or more numbers they must be expressed to the same power of ten.
- To multiply two or more numbers add the powers of ten.
- To divide two or more numbers subtract the powers of ten.

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MODULES 5/6 FOOD AND DRINK:
A CHEMICAL STORY

Some key points introduced in these Modules:

- Each type of atom has a characteristic number of protons e.g. hydrogen has 1. It is the number of protons in an atom that determines the type of element it is.
- There are two kinds of bonds between atoms: covalent and ionic.
- Chemical equations must balance; the number of atoms of each type of element on both sides of the equation should be equal.

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MODULES 7 AND 8



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MODULE 7 LIVING MATERIAL
MODULE 8 ENERGY

Module 7 introduces graphs. A graph requires:

- a title (description of the data)
- axes (labelled with variables/units)
- scales (numbers along axes).

Different forms of energy introduced in Module 8:

Form of energy	Brief description
Chemical energy	energy released when a chemical reaction occurs. The term is often used to refer to the energy that <i>could</i> be released <i>if</i> the reaction occurred
Electrical energy	energy available when an electric current flows
Gravitational energy	energy possessed by an object because of its position
Heat energy (internal energy)	energy possessed by substances as a consequence of internal movements of various kinds of their particles (molecules, atoms etc.)
Heat energy (radiant energy)	energy possessed by microwave and infrared radiation—part of the electromagnetic spectrum
Kinetic energy	energy possessed by an object because it is moving
Light energy	energy possessed by visible light—another part of the electromagnetic spectrum
Sound energy	energy possessed by sound. It is related to kinetic energy
Strain energy	energy possessed by an object because it is deformed in some way.

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MODULES 9 AND 10



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MODULE 9 NAVIGATING AROUND
MODULE 10 SURVEYING

These formulae and concepts are introduced in Module 9:

- Diameter of a circle = $2r$
- Circumference of a circle = $2\pi r$
- Area of a circle = πr^2
- Volume of a sphere = $\frac{4\pi r^3}{3}$
- Surface area of a sphere = $4\pi r^2$
- A circle has 360° , a straight line has 180° , a right angle has 90°
- Lines of longitude are all Great Circles (circumferences) of the Earth
- Lines of latitude are parallel to each other; only the Equator is a Great Circle
Lines of latitude get smaller towards the Poles
- The angles of a triangle add up to 180°

Formulae introduced in Module 10:

$$\sin \alpha = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos \alpha = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan \alpha = \frac{\text{opposite}}{\text{adjacent}}$$

$y = mx$, where m is the gradient

$y = mx + c$, where m is the gradient and c is the intercept.

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MODULES 11 AND 12



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MODULE 11 GOOD WRITING IN SCIENCE
MODULE 12 FOSSIL FUELS AND CLIMATE CHANGE

Module 11 introduces hints on answering questions in science:

- mathematical answers must give units and include all stages of calculations
- diagrams and equations should be an integral part of the answer
- all diagrams should be fully labelled.
- When producing a scientific account break it into steps: read the question, collect the information, organise the content so that one point flows on to the next, write your answer, and review your answer.

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WORKBOOK

The Workbook has exercises in maths and aspects of chemistry. The list below gives the principles and concepts that you can practise in the Workbook, and where you can find them in the Modules.

Module

- 1 The order of doing arithmetic (BODMAS), Decimals, Number of decimal places, Negative numbers.
- 2 Fractions, Ratios, Percentages, SI units, Significant figures.
- 3 Area of rectangles, Volume of rectangular solids, Density, Introduction to triangles: Pythagoras' theorem.
- 4 Powers of ten, Scientific notation.
- 5/6 Chemical formulae, Chemical equations, Relative mass.
- 7 Graphs, Exponential growth, More about powers (x^y).
- 8 Algebra, Rearranging equations.
- 9 Circles: radius, diameter, circumference, area. Spheres: volume, surface area. More about triangles: equilateral triangles.
- 10 More triangles: similar, isosceles. Trigonometry: sine, cosine, tangent. Graphs: equation, gradient, intercept. Proportion.

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